XI. "On the Change produced by Magnetization in the Electrical Resistance of Iron and Steel.—Preliminary Notice." By Professor W. G. Adams, F.R.S. Received June 1, 1875.

For some time past Mr. Herbert Tomlinson, Demonstrator in the Physical Laboratory of King's College, has been engaged in carrying out a series of experiments on this subject, and also on the effect of change of tension on the electrical resistance of steel and iron wires.

In measuring the resistances of the short lengths of the wires or rods which were employed, a unit was chosen which was a small fraction of the British-Association unit.

Experiments were made with rods of soft iron about one eighth of an inch thick, with soft steel, and also with steel of different degrees of hardness.

With a rod of soft iron about 3 feet long there was an increase of resistance of about 1 per cent. on magnetizing with two Grove's cells. The whole resistance of this rod was 32 units.

The experiments were repeated with the rod placed in ice and also in water at the ordinary temperature (about 15° C.), and with nearly the same change in the resistance of the rod. The change in the temperature of the water was found to be about 1° C. during the experiment.

Another rod of soft iron was employed whose resistance was 50 units. The magnetizing current was measured by means of a tangent-galvanometer, and the resistance was measured by means of Wheatstone's bridge. There was found to be an increase in the resistance of the rod when it was converted into a magnet by sending the magnetizing current through a wire which was coiled round it in the form of a spiral.

It was found that the electrical resistance was increased when any addition was made to the strength of the magnetizing current. When the increase in the electrical resistance was divided by the square of the strength of the magnetizing current, a series of numbers was obtained which did not differ much from one another; the values of these numbers mostly lie between 3 and 4.

When the magnetizing current is considerably increased, the ratio of the increase in the resistance to the square of the magnetizing current diminishes rather rapidly.

A similar series of experiments was made with a thick knitting-needle made of *soft steel*. The resistance of the needle was 29 units. In this case also the resistance was found to *increase* when the strength of the magnetizing current was increased. On dividing the increase of resistance by the square of the magnetizing current, the numbers obtained from a considerable number of experiments lie between 4·7 and 5·6, showing that the ratio of the increase of resistance to the square of the magnetizing current is very nearly constant.

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When the magnetizing current is considerably increased, this ratio is found to diminish, just as in the case of soft iron.

Different kinds of *hard* steel were tried.

(1) An ordinary knitting-needle, of which the resistance was 66·5 units.

On magnetizing with currents of different strengths, there was found to be a diminution in the resistance; and it was also found that the diminution of resistance increased when the strength of the current was increased. With currents varying from tan 15° to tan 54° 30′ the diminution amounted to 4·33, *i. e.* about 6·5 per cent. of the whole resistance. The temperature *increased* about 2° C. during the experiment.

Dividing the loss of resistance by the square of the magnetizing current, the results of four sets of experiments gave the following values :—

$$\frac{\cdot 165}{(\tan 15^\circ)^2}=2\cdot 29,$$

$$\frac{\cdot 7525}{(\tan 30^\circ)^2}=2\cdot 26,$$

$$\frac{2\cdot 3225}{(\tan 45^\circ\ 30')^2}=2\cdot 24,$$

$$\frac{4\cdot 330}{(\tan 54^\circ\ 30')^2}=2\cdot 21.$$

Four Grove's cells were employed for the strongest current.

Two other experiments which had been tried previously gave results 2·30 and 2·26 for the ratio of the diminution of resistance to the square of the magnetizing current, thus showing that the diminution in the resistance is almost exactly proportional to the square of the current.

The diminution in resistance does not take place all at once, but gradually, and also ceases gradually when the current is stopped.

(2) A steel needle was also magnetized longitudinally by placing it on a copper strip at right angles to the lines of force of a current across the strip.

There was found to be diminution of resistance on increasing the current. The values obtained from two series of experiments were :—

$$\frac{\cdot 064}{(\tan 8^\circ\ 30')^2}=2\cdot 88,$$

$$\frac{\cdot 192}{(\tan 15^\circ)^2}=2\cdot 63.$$

With stronger currents this ratio was found to diminish.

On magnetizing the wires transversely by sending a current in the direction of their length, a diminution of resistance was also observed, which diminution also increased when the strength of the current was increased.

When a current was sent along the wire itself, on increasing the current there was found to be also a diminution of resistance in the case of hard steel, and an increase of resistance in the case of soft iron and soft steel.

Thus the effects produced are the same as those due to transverse magnetization by a neighbouring current.

Conclusions to be drawn from the experiments:—

(1) The effect of passing any current through a bar of hard steel is to diminish its resistance, and through a bar of soft iron or soft steel is to increase its resistance.

(2) When a bar of hard steel is magnetized by sending a current through a coil which encloses it, there is a diminution of resistance which is directly proportional to the square of the magnetizing current up to a certain limit.

(3) When soft steel or soft iron is magnetized longitudinally or transversely, there is an increase of resistance which is nearly proportional to the square of the magnetizing current.

XII. "The Action of Light on Selenium." By Prof. W. G. Adams, M.A., F.R.S. Received June 17, 1875.

(Abstract.)

The paper contains an account of several series of experiments made in December and January last on this subject with the view:—

(1) To determine whether the change in the electrical resistance of the selenium is due to radiant heat, light, or chemical action.

(2) To measure the amount of the change of resistance due to exposure to light from different sources and through various absorbing media.

(3) To determine whether the action is instantaneous or gradual, and, if possible, to measure the rate at which the action takes place.

The selenium formed one of the four resistances in a Wheatstone's bridge, and its average resistance was about 2½ megohms.

The two resistances in the bridge, which were kept constant, were 4 and 2000, so that the resistance of the selenium was 500 times the variable resistance required to balance it.

R is taken to represent this resistance required to balance the selenium. The box containing the selenium was laid on its side and had a draw-lid, which was kept closed except when exposure was made. In front of the draw-lid was a black screen with an opening opposite to the selenium 6 centims. by 3½ centims., into or in front of which various absorbing media could be placed.

The absorbing media employed were bichromate of potash, sulphate of copper, ruby, orange, green, and blue glasses. Plates of rock-salt, alum, mica, and quartz were also employed.

With the lid of the box on, the resistance of the selenium was measured, and was found to increase slowly and regularly in consequence of the